PATENT ABSTRACTS OF JAPAN

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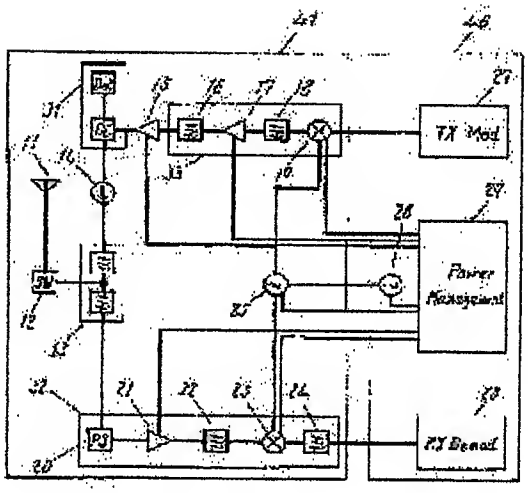
(54) HIGH FREQUENCY RADIO

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent a high frequency radio utilized for a portable telephone and an information communication terminal from being deteriorated in the reception sensitivity.
SOLUTION: The high frequency radio can be prevented from being deteriorated in reception sensitivity by arranging an antenna port 11, an antenna switch 12, an antenna multicoupler 13, an isolator 14, a power amplifier 15, a 1st filter 16, a transmission amplifier 17, a 2nd filter 18, a transfer mixer 19, a phase shifter 20, a low noise amplifier 21, a 3rd filter 22, a reception mixer 23, a 4th filter 24 and a PLL oscillator 25 on one side 41 of a multi-layered board, and arranging a reference signal oscillator 26, a transmission modulator 27, a reception demodulator 28, and a power supply control circuit 289 on another side 46 of the multi-layered board.



CLAIMS

[Claim(s)]

[Claim 1]An antenna switch is connected to one field of a multilayer substrate between an antenna port and an antenna terminal of an antenna shared device, An isolator is connected between a transmission terminal of said antenna shared device, and an output terminal of a power amplifier, Power detectors are connected between an output terminal of said power amplifier, and a power monitor output port, The 1st filter is connected between an input terminal of said power amplifier, and an output terminal of a transmission amplifier, The 2nd filter is connected between an input terminal of said transmission amplifier, and an RF output terminal of a transmission mixer, Make IF input terminal of said transmission mixer into IF input port, and a phase converter is connected between receiving terminals of said antenna shared device, and an input terminal of a low noise amplifier, The 3rd filter is connected between an output terminal of said low noise amplifier, and an RF input terminal of a receiving mixer, The 4th filter is connected with an IF output terminal of said receiving mixer between IF output ports, A circuit connected to an output terminal of a PLL oscillator while connecting LO input terminal of said transmission mixer and LO input terminal of said receiving mixer is constituted, Provide a transmit modulation machine, a receiving demodulator, a control circuit, a reference signal oscillator, and a signal connection terminal in a field of another side of said multilayer substrate, and said IF input port is connected to an output terminal of said transmit modulation machine, High frequency radio equipment which connected said IF output port to an input terminal of said receiving demodulator, and connected an output of said reference signal oscillator to an input terminal of said PLL oscillator.

[Claim 2]A multilayer substrate is constituted from at least six or more layers including one field and a field of another side, The high frequency radio equipment according to claim 1 which made said one field the 1st layer, made a field of said another side the 6th layer, made a ground pattern the 2nd layer and the 4th layer, connected a circuit established in said one field by said 1st layer and the 3rd layer, and connected a circuit established in a field of said another side by the 5th layer and said 6th layer.

[Claim 3]The high frequency radio equipment according to claim 1 which carried out power control of a transmission amplifier, a transmission mixer, a low noise amplifier, and the receiving mixer with the 1st regulator, carried out power control of a PLL oscillator and the reference signal oscillator with the 2nd regulator, and carried out power control of a transmit modulation machine and the receiving demodulator with the 3rd regulator.

[Claim 4]A drain terminal of a transistor which carries out power control of the power amplifier, The high frequency radio equipment according to claim 1 constituting from at least four or more terminals, and distributing two or more terminals of drain terminals of said transistor which carries out power control to the 1st power supply terminal of said power amplifier, and each 2nd power supply terminal of said power amplifier.

[Claim 5]The high frequency radio equipment according to claim 1 which established a notch

circuit in LO input terminal of a receiving mixer.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the high frequency radio equipment used for a cellular phone or an information-and-telecommunications terminal.
[0002]
[Description of the Prior Art]Conventionally, this kind of high-frequency-radio-communications circuit apparatus had become the composition shown in drawing 6. In drawing 6, 11 an antenna port and 12 an antenna switch and 13 An antenna shared device, An isolator and 15 for 14 a power amplifier and 16 the 1st filter and 17 A transmission amplifier, The 2nd filter and 19 for 18 a transmission mixer and 20 a phase converter and 21 A low noise amplifier, 22 -- the 3rd filter and 23 -- a receiving mixer and 24, a receiving demodulator and 29 are control circuits, as for the 4th filter and 25, a transmit modulation machine and 28 constituted these [all] in one field 41 of the multilayer substrate a reference signal oscillator and 27, as for a PLL oscillator and 26, and the field of another side was used as the ground pattern.
[0003]
[Problem(s) to be Solved by the Invention]When all the circuits were constituted in one field of a multilayer substrate, the digital noise generated from a transmit modulation machine or a receiving demodulator mixed in the antenna or the low noise amplifier, and the technical problem that receiving sensitivity was degraded occurred. In this high frequency radio equipment, the improvement in receiving sensitivity in an antenna port is demanded.
[0004]This invention by providing a ground pattern in the inner layer of a multilayer substrate, while arranging the transmit modulation machine and receiving demodulator which are made to generate a digital noise to the field of another side of a different side from one field of the multilayer substrate which arranges the antenna port and the low noise amplifier, A digital noise is prevented from mixing in an antenna or a low noise amplifier, and it aims at raising the receiving sensitivity of high frequency radio equipment.
[0005]
[Means for Solving the Problem]To achieve the above objects, a high-frequency-radio-communications circuit apparatus by this invention, An antenna switch is connected to one field of a multilayer substrate between an antenna port and an antenna terminal of an antenna shared device, An isolator is connected between a transmission terminal of said antenna shared device, and an output terminal of a power amplifier, Power detectors are connected between an output terminal of said power amplifier, and a power monitor output port, The 1st filter is connected between an input terminal of said power amplifier, and an output terminal of a transmission amplifier, The 2nd filter is connected between an input terminal of said transmission amplifier, and an RF output terminal of a transmission mixer, Make IF input terminal of said transmission mixer into IF input port, and a phase converter is connected between

receiving terminals of said antenna shared device, and an input terminal of a low noise amplifier, The 3rd filter is connected between an output terminal of said low noise amplifier, and an RF input terminal of a receiving mixer, The 4th filter is connected with an IF output terminal of said receiving mixer between IF output ports, While connecting LO input terminal of said transmission mixer, and LO input terminal of said receiving mixer, constitute a circuit linked to an output terminal of a PLL oscillator, and a transmit modulation machine, a receiving demodulator, a control circuit, a reference signal oscillator, and a signal connection terminal are provided in a field of another side of said multilayer substrate, Said IF input port was connected to an output terminal of said transmit modulation machine, said IF output port was connected to an input terminal of said receiving demodulator, and an output of said reference signal oscillator was connected to an input terminal of said PLL oscillator.

[0006]A digital noise can be prevented from mixing in an antenna port and a low noise amplifier of high frequency radio equipment by this, and receiving sensitivity can be raised.

[0007]

[Embodiment of the Invention]The invention of this invention according to claim 1 connects an antenna switch to one field of a multilayer substrate between an antenna port and the antenna terminal of an antenna shared device, An isolator is connected between the transmission terminal of said antenna shared device, and the output terminal of a power amplifier, Power detectors are connected between the output terminal of said power amplifier, and a power monitor output port, The 1st filter is connected between the input terminal of said power amplifier, and the output terminal of a transmission amplifier, The 2nd filter is connected between the input terminal of said transmission amplifier, and the RF output terminal of a transmission mixer, Make IF input terminal of said transmission mixer into IF input port, and a phase converter is connected between the receiving terminals of said antenna shared device, and the input terminal of a low noise amplifier, The 3rd filter is connected between the output terminal of said low noise amplifier, and the RF input terminal of a receiving mixer, The 4th filter is connected with the IF output terminal of said receiving mixer between IF output ports, While connecting LO input terminal of said transmission mixer, and LO input terminal of said receiving mixer, constitute the circuit linked to the output terminal of the PLL oscillator, and a transmit modulation machine, a receiving demodulator, a control circuit, a reference signal oscillator, and a signal connection terminal are provided in the field of another side of said multilayer substrate, Connect said IF input port to the output terminal of said transmit modulation machine, and said IF output port is connected to the input terminal of said receiving demodulator, The output of said reference signal oscillator is connected to the input terminal of said PLL oscillator, and it has the operation that the digital noise from a transmit modulation machine and a receiving demodulator can be prevented from mixing in the antenna port and low noise amplifier of high frequency radio equipment.

[0008]The invention according to claim 2 constitutes a multilayer substrate from at least six or more layers including one field and the field of another side, Make said one field into the 1st layer, make the field of said another side into the 6th layer, and a ground pattern is made into the 2nd

layer and the 4th layer, The circuit established in said one field is connected by said 1st layer and the 3rd layer, the circuit established in the field of said another side is used as the high frequency radio equipment according to claim 1 connected by the 5th layer and said 6th layer, and it has the operation that the receiving sensitivity of high frequency radio equipment can be improved.

[0009]The invention according to claim 3 carries out power control of a transmission amplifier, a transmission mixer, a low noise amplifier, and the receiving mixer with the 1st regulator, Power control of a PLL oscillator and the reference signal oscillator is carried out with the 2nd regulator, and it is considered as the high frequency radio equipment according to claim 1 which carried out power control of a transmit modulation machine and the receiving demodulator with the 3rd regulator, and has the operation that receiving standby time can be improved.

[0010]The drain terminal of a transistor in which the invention according to claim 4 carries out power control of the power amplifier, Constitute from at least four or more terminals, and it is considered as the high frequency radio equipment according to claim 1 distributing two or more terminals of drain terminals of said transistor which carries out power control to the 1st power supply terminal of said power amplifier, and each 2nd power supply terminal of said power amplifier, It has the operation that the transmit modulation distortion characteristic of high frequency radio equipment is improvable.

[0011]The invention according to claim 5 is the high frequency radio equipment which established the notch circuit in LO input terminal of the receiving mixer, and has the operation that the reception interference exclusion characteristic of high frequency radio equipment can be improved.

[0012]Hereafter, an embodiment of the invention is described using drawing 5 from drawing 1.

[0013](Embodiment 1) Drawing 1 is an electric diagram showing the high-frequency-radio-communications circuit apparatus by the embodiment of the invention 1. The antenna switch 12 connected between the antenna port 11 and the antenna shared device 13 is formed in order to examine a high-frequency-radio-communications circuit apparatus from the exterior. In this embodiment, although the switch 12 uses the thing of the type which changes a signal path mechanically, the thing using a semiconductor device may be used for it.

[0014]The antenna shared device 13 is formed in order to separate transmit frequency and received frequency, and it is realizing separation characteristics which a transmission output does not reveal to a receiver in particular. These separation characteristics are not less than 56 dB so that receiving sensitivity may not deteriorate. Although SAW constitutes the antenna shared device 13, a dielectric may constitute it from this embodiment.

[0015]The low noise amplifier 21 is formed for low-noise-izing of a receiver, and is raising the receiving sensitivity of a system. According to this embodiment, the forward power profit of the low noise amplifier 21 shall be not less than 16 dB, and the 3rd intermodulation strain characteristic of 1.5 dB or less and input conversion is the noise figure +1 dBm or more. He is using the low noise amplifier 21 as a gain control type amplifier into which a profit is changed, and is trying to also bear a strong electric field interference. The variable gain range is constituted

from not less than 15 dB, and receiving sensitivity is kept from deteriorating also on a −21−dBm interference level in the antenna port 11 at this time.

[0016]By providing between the antenna shared device 13 and the low noise amplifier 21, the phase converter 20 is constituted so that transmission frequency bands may not carry out an impedance match by a complex conjugate. By carrying out like this, it becomes possible to be able to reduce the power level which transmission frequency bands mix in the low noise amplifier 21, and to raise the disturbance exclusion characteristic as a result. The phase converter 20 adds a certain thing, also when not required. The conditions with the unnecessary phase converter 20 are the cases where the transmission−frequency−bands impedance of the receiving terminals of the antenna shared device 13 and the input impedance of the low noise amplifier 21 do not consistent by a complex conjugate.

[0017]The 3rd filter 22 is a filter which attenuates a transmission band while passing a receiving band, and SAW was used for it by this embodiment. At this time, the magnitude of attenuation of the transmission band may be not less than 15 dB.

[0018]The receiving mixer 23 is formed in order to carry out frequency conversion of the input signal to an IF signal, and it consisted of dual gate type mixers. The characteristic sets a forward power profit to not less than 8 dB, and is the 3rd intermodulation strain characteristic of 8 dB or less and input conversion not less than +3 dBm in noise figure. In order to fill this characteristic, the GaAsMESFET device was used for the receiving mixer 23 in this embodiment.

[0019]Since the 4th filter 24 attenuates other zones while passing the IF signal which carried out frequency conversion with the receiving mixer 23, it has been formed, and it consists of SAW devices. It connects with the receiving demodulator 28 and the output of the 4th filter 24 constitutes the receive section.

[0020]Next, a transmission section is explained. The isolator 14 is connected between the power amplifier 15 and the antenna shared device 13, and even if it changes the load of the power amplifier 15 by the antenna port 11, the adjacent channel leak power characteristic of the power amplifier 15 is kept from deteriorating. The electric power detector circuit 31 is formed in order to monitor transmission power, and it is connected to the input side of the isolator 14 in order to reduce the influence by the load change of the power amplifier 15.

[0021]The 1st filter 16 is formed in order to attenuate a receiving band, while passing a transmission band. The magnitude of attenuation of the receiving band is setting to not less than 30 dB, and he is trying for receiving band noise level to turn into a thermal noise level by the input side of the power amplifier 15. The transmission amplifier 17 is formed in order to amplify to the input level which the power amplifier 15 needs. The transmission amplifier 17 is used as the gain control type amplifier, and even when changing transmission power to a minimum output level, transmission band noise level is kept from increasing in this embodiment.

[0022]The 2nd filter 18 is formed in order to attenuate a receiving band, while passing a transmission band. According to this embodiment, SAW was used. The transmission mixer 19 is formed in order to change a transmitting IF signal into transmit frequency, and it is connected

with the output of the transmit modulation machine 27. PLL oscillator 25 is made into the local signal source to the receiving mixer 23 and the transmission mixer 19. The reference signal oscillator 26 is a reference frequency source of PLL oscillator 25. The control circuit 29 is formed in order to control the power supply of the power amplifier 15, the transmission amplifier 17, the transmission mixer 19, the low noise amplifier 21, the receiving mixer 23, PLL oscillator 25, and the reference signal oscillator 26.

[0023]As shown in drawing 1, the multilayer substrate was used in this embodiment. To one field 41 of a multilayer substrate. The antenna port 11, the antenna switch 12, the antenna shared device 13, the isolator 14, the power amplifier 15, the 1st filter 16, the transmission amplifier 17, the 2nd filter 18, the transmission mixer 19, the phase converter 20, the low noise amplifier 21, the 3rd filter 22, the receiving mixer 23, The 4th filter 24 and PLL oscillator 25 are arranged. Thus, one field 41 of the multilayer substrate is made to constitute the parts which deal with the frequency component more than a VHF band as a signal.

[0024]On the other hand, in the field 46 of another side of a multilayer substrate, the reference signal oscillator 26, the transmit modulation machine 27, the receiving demodulator 28, and the control circuit 29 are arranged. Thus, the field 46 of another side of a multilayer substrate is made to constitute the parts which deal with the frequency component below HF bands as a signal.

[0025]It becomes possible to shut up DC lines connected to the ground pattern 42 of the 2nd layer, and the ground pattern 44 of the 4th layer in respect of [41] one side of a multilayer substrate by making it arrange in this way, such as a power source line and a gain control line, electromagnetic, The frequency component more than a VHF band is made into a signal. The antenna port 11 arranged to one field 41 of the multilayer substrate to deal with, the antenna switch 12, the antenna shared device 13, the isolator 14, the power amplifier 15, the 1st filter 16, the transmission amplifier 17, the 2nd filter 18, the transmission mixer 19, the phase converter 20, the low noise amplifier 21, It can prevent mixing in the 3rd filter 22, the receiving mixer 23, the 4th filter 24, and PLL oscillator 25 the digital noise centering on the signal component of the HF bands generated from the transmit modulation machine 27 and the receiving demodulator 28 which have been arranged to the field 46 of another side of a multilayer substrate. As a result, it becomes possible to prevent receiving sensitivity degradation of a high-frequency-radio-communications circuit apparatus.

[0026](Embodiment 2) Drawing 2 is a perspective view of the high-frequency-radio-communications circuit apparatus in which the embodiment of the invention 2 is shown. PLL oscillator 25 is arranged so that it may surround in the receive section 32 and the transmission section 33, and it constitutes to the antenna port 11 in a position which serves as a vertical angle. By making it arrange in this way, it considers so that the local signal from PLL oscillator 25 may not mix in the antenna port 11 directly. As shown in drawing 2, a multilayer substrate reaches 2nd layer 42 and 44 [layer / 4th] is a ground pattern. the circuit connection arranged to one field 41 of a multilayer substrate -- one field 41 of a multilayer substrate, and a multilayer substrate -- the 3rd layer is carried out by 43. the circuit connection

of the transmit modulation machine 27 made to generate a digital noise and the receiving demodulator 28 — the field 46 of another side of a multilayer substrate, and a multilayer substrate — the 5th layer is carried out by 45. Thus, in respect of [46] another side of 45 and a multilayer substrate, the 5th layer of the part which deal with the frequency component below HF bands as a signal is constituted and arranged. Especially the 5th layer carries out circuit connection of a direct current signal line, a gain control line, and the data line.

[0027]On the other hand, the 2nd layer of circuit connection [the 3rd layer of / the 4th layer of] of the parts which deal with the frequency component more than a VHF band as a signal is carried [field / 41 / of a multilayer substrate / one / 42] out by 44 with 43. Thus, the 1st layer of the frequency component [the 4th layer of] more than a VHF band is made to deal with even 44 as a signal from 41. By dividing the frequency component of the signal dealt with to the layer direction of a multilayer substrate, arranging, and connecting, as shown in this embodiment, The ground pattern constituted from the 2nd layer of a multilayer substrate and the 4th layer will make the shielding effect over a digital noise improve further, and will heighten the receiving sensitivity deterioration prevention effect of a high-frequency-radio-communications circuit apparatus as a result.

[0028](Embodiment 3) In this embodiment, the circuit controlled in the control circuit 29 to be shown in drawing 3 is divided into four. As for the 15 or 2nd power amplifier, the 1st PLL oscillator 25 and 26 or 4th reference signal oscillator of the transmission amplifier 17, the transmission mixer 19, the low noise amplifier 21, and the 23 or 3rd receiving mixer are the transmit modulation machine 27 and the receiving demodulator 28. The 1st power amplifier 15 is carrying out power control 70 by P channel MOS FET. It becomes possible to be individual and to carry out power control of the power amplifier 15 with which current flows most at the time of transmission by this.

[0029]Next, although it is about the 2nd power control 71, the power supply of the receive section 32 which constitutes the block of the transmission section 33 and receiver which constitute the small signal block of the transmitting side from this embodiment is summarized. While being able to carry out independent control of the transmission section 33 only by adding a transistor switch to the power source line of the transmission section 33 by collecting in this way, when carrying out power control of the receive section 32, it becomes possible for the transmission section 33 to also make it interlock and to control.

[0030]It is how to pack PLL oscillator 25 and the reference signal oscillator 26 about the 3rd power control 72. Thus, by packing only an oscillation block, it becomes possible to operate only a circuit block required for the timing synchronization at the time of a system startup.

[0031]Although it is the transmit modulation machine 27 and the receiving demodulator 28, this has formed the 4th power control 73 in order to always start a digital part. By always starting a digital part, it becomes possible to monitor a system action continuously, and it becomes possible only for timing required for a required circuit to make a power supply control. Since the intermittent control action only of the circuit part (the transmission amplifier 17, the transmission mixer 19, the low noise amplifier 21, the receiving mixer 23) required at the time of the waiting

receptacle for reception can be carried out by making it classify in this way, it becomes possible as a result to lengthen receiving standby time.

[0032](Embodiment 4) Drawing 4 is an electric diagram of the high-frequency-radio-communications circuit apparatus in which the embodiment of the invention 4 is shown. As shown in drawing 4, the 1st power supply terminal 51 and 2nd power supply terminal 52 of the power amplifier 15 are connected to the drain 53 of P channel MOS FET50. At this time, the 1st power supply terminal 51 and 2nd power supply terminal 52 of the power amplifier 15 are connected so that four terminals of the drain 53 of P channel MOS FET50 may be bisected. And in this state, the 1st capacitor 48 is connected with the 1st power supply terminal 51 of the power amplifier 15 between groundings, and the 2nd capacitor 49 is connected with the 2nd power supply terminal 52 of the power amplifier 15 between groundings.

[0033]Thereby, a filter comprises a track of the 1st capacitor 48 and the 1st power supply terminal 51, and a filter comprises a track of the 2nd capacitor 49 and the 2nd power supply terminal 52. The filter constituted at this time is an effective filter from which the noise component mixed from a power supply terminal to the clock frequency of the power amplifier 15 is removable.

[0034]If the power supply terminal 51 and the power supply terminal 52 are connected, line length will become short, and will be an effective filter on frequency higher than the clock frequency of the power amplifier 15, and it will become impossible to prevent degradation of the modulation distortion characteristic of the transmission output wave amplified with the power amplifier 15.

[0035]As shown in this embodiment, it becomes possible by separating the 1st power supply terminal 51 and 2nd power supply terminal 52 of the power amplifier 15 to prevent degradation of the modulation distortion characteristic of the transmission output wave which could carry out high frequency separation after each power supply terminal had become independent, and was amplified with the power amplifier 15 as a result.

[0036](Embodiment 5) Drawing 5 is an electric diagram of the high-frequency-radio-communications circuit apparatus in which the embodiment of the invention 5 is shown. As shown in drawing 5, the notch filter 47 is connected to the output of PLL oscillator 25. According to this embodiment, frequency of the notch filter 47 is made into transmission frequency bands. Although SAW, LC, and a dielectric may be sufficient as this notch filter 47, a chip type capacitor which serves as self-resonant frequency in transmission frequency bands is being used for it in order to simplify circuitry.

[0037]By constituting in this way, the sending signal amplified with the power amplifier 15 can prevent mixing in the receiving mixer 23. As a result, it becomes possible to prevent degradation of receiving sensitivity. If the sending-signal level and other noise level which are mixed in the receiving mixer 23 are below the level, i.e., a thermal noise level, which does not cause degradation of receiving sensitivity, it will add that the notch filter 47 becomes unnecessary.

[0038]

[Effect of the Invention]As mentioned above, according to this invention, it becomes possible to

prevent mixing of the antenna port of a high-frequency-radio-communications circuit apparatus, and the digital noise to a low noise amplifier, and the advantageous effect that the technical problem that receiving sensitivity is degraded is solvable is acquired.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The electric diagram showing the high-frequency-radio-communications circuit apparatus by the embodiment of the invention 1

[Drawing 2]The perspective view showing the high-frequency-radio-communications circuit apparatus by the embodiment of the invention 2

[Drawing 3]The electric diagram showing the high-frequency-radio-communications circuit apparatus by the embodiment of the invention 3

[Drawing 4]The electric diagram showing the high-frequency-radio-communications circuit apparatus by the embodiment of the invention 4

[Drawing 5]The electric diagram showing the important section composition of the high-frequency-radio-communications circuit apparatus by the embodiment of the invention 5

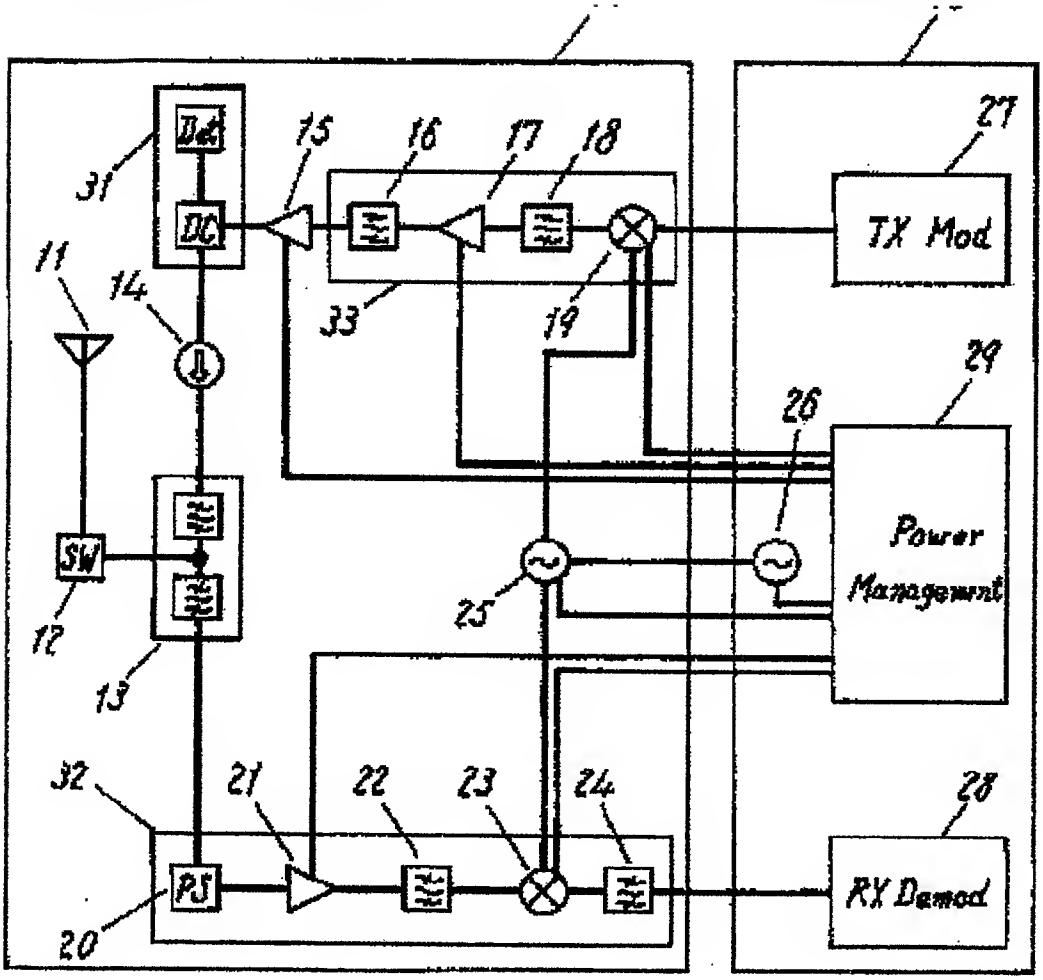
[Drawing 6]The electric diagram showing the conventional high-frequency-radio-communications circuit apparatus

[Description of Notations]

11 Antenna port
12 Antenna switch
13 Antenna shared device
14 Isolator
15 Power amplifier
16 The 1st filter
17 Transmission amplifier
18 The 2nd filter
19 Transmission mixer
20 Phase converter
21 Low noise amplifier
22 The 3rd filter
23 Receiving mixer
24 The 4th filter
25 PLL oscillator
26 Reference signal oscillator
27 Transmit modulation machine
28 Receiving demodulator
29 Control circuit
31 Electric power detector circuit
32 Receive section
33 Transmission section
41 One field of a multilayer substrate (the 1st layer)

42 The 2nd layer
43 The 3rd layer
44 The 4th layer
45 The 5th layer
46 The field of another side of a multilayer substrate (the 6th layer)
47 Sauce
48 The 1st capacitor
49 The 2nd capacitor
50 P channel MOS FET
51 The 1st power supply terminal
52 The 2nd power supply terminal

[Translation done.]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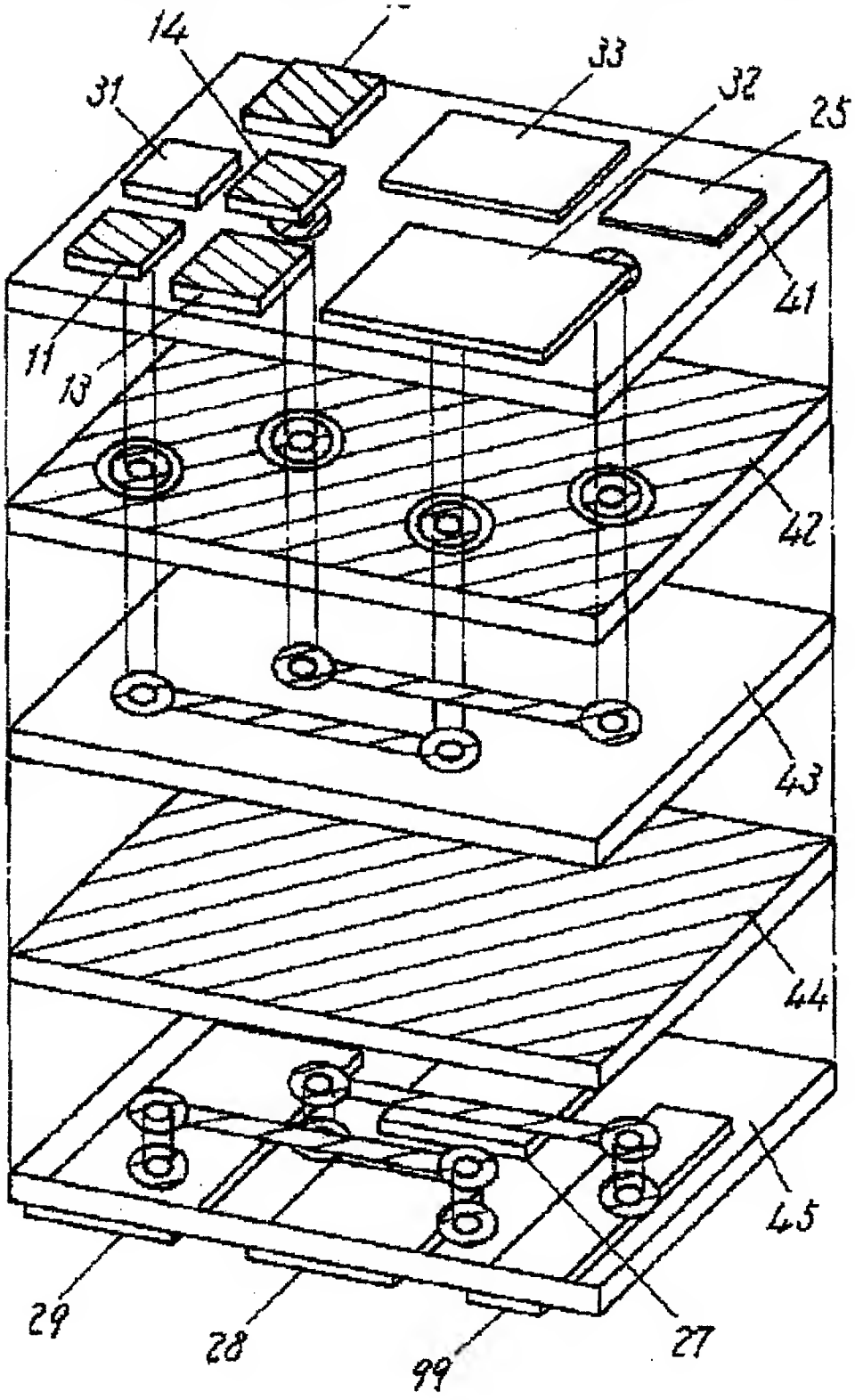
Drawing 1



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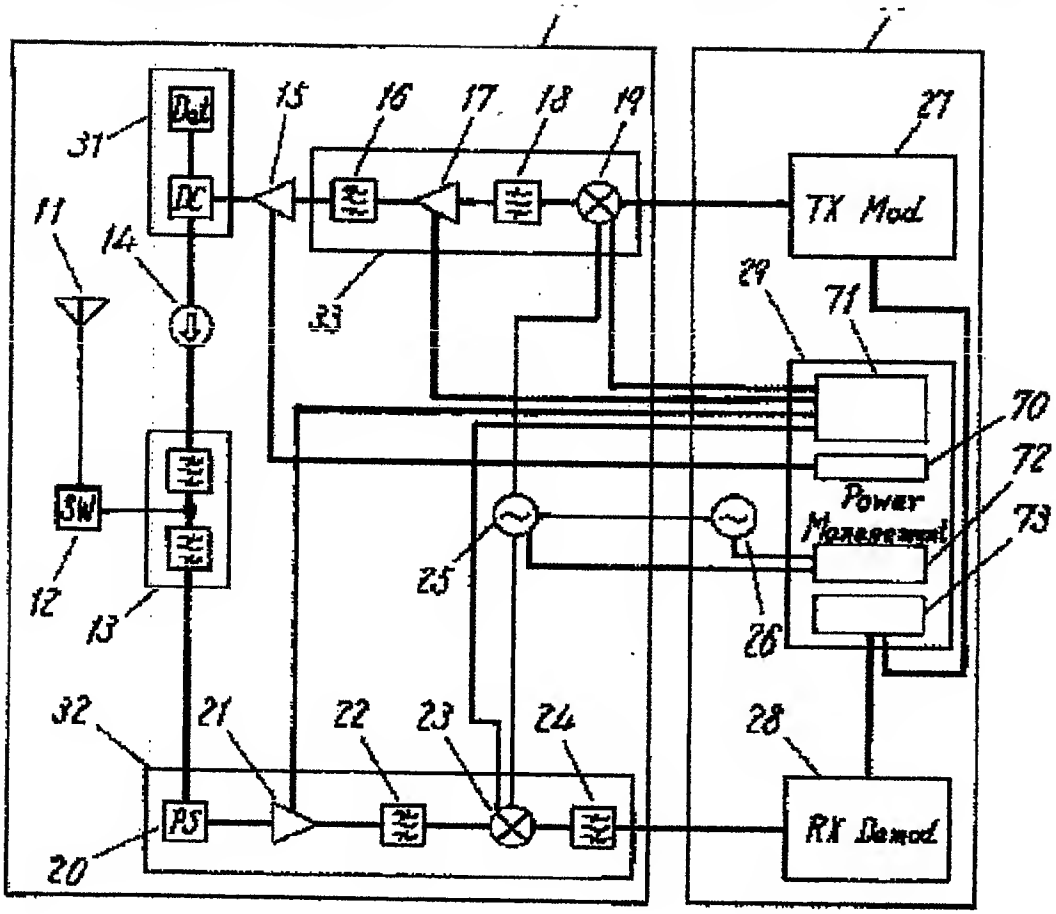
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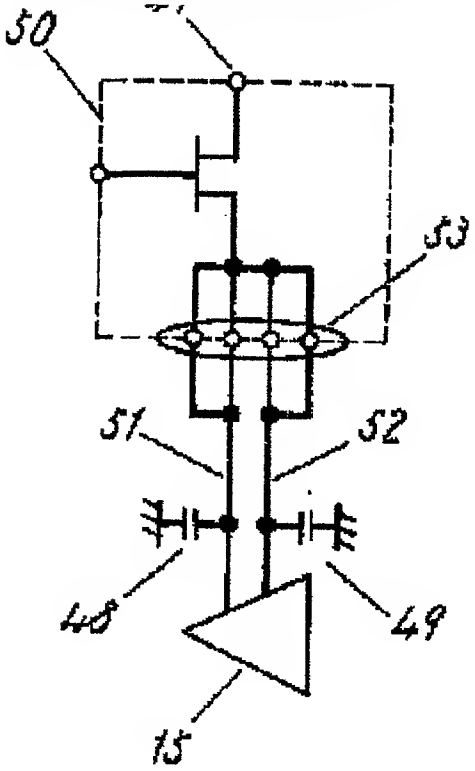
Drawing 3



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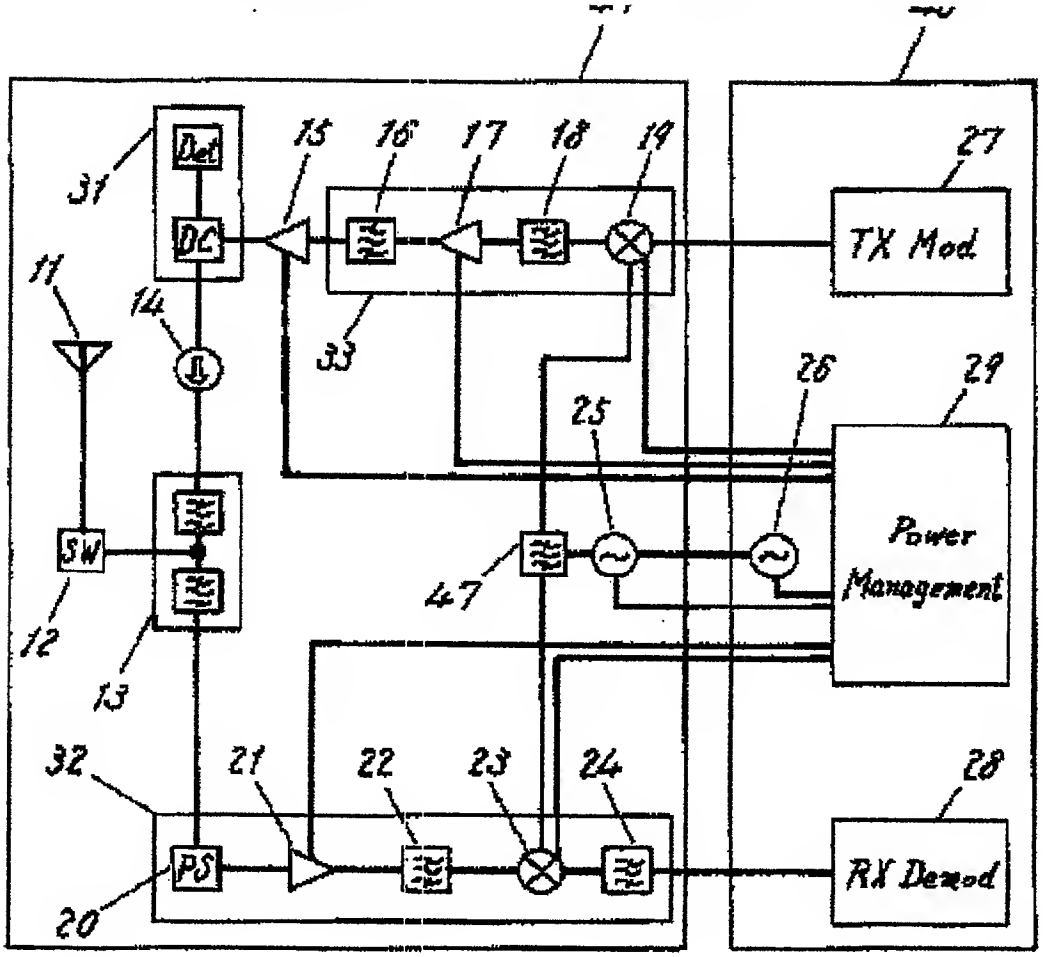
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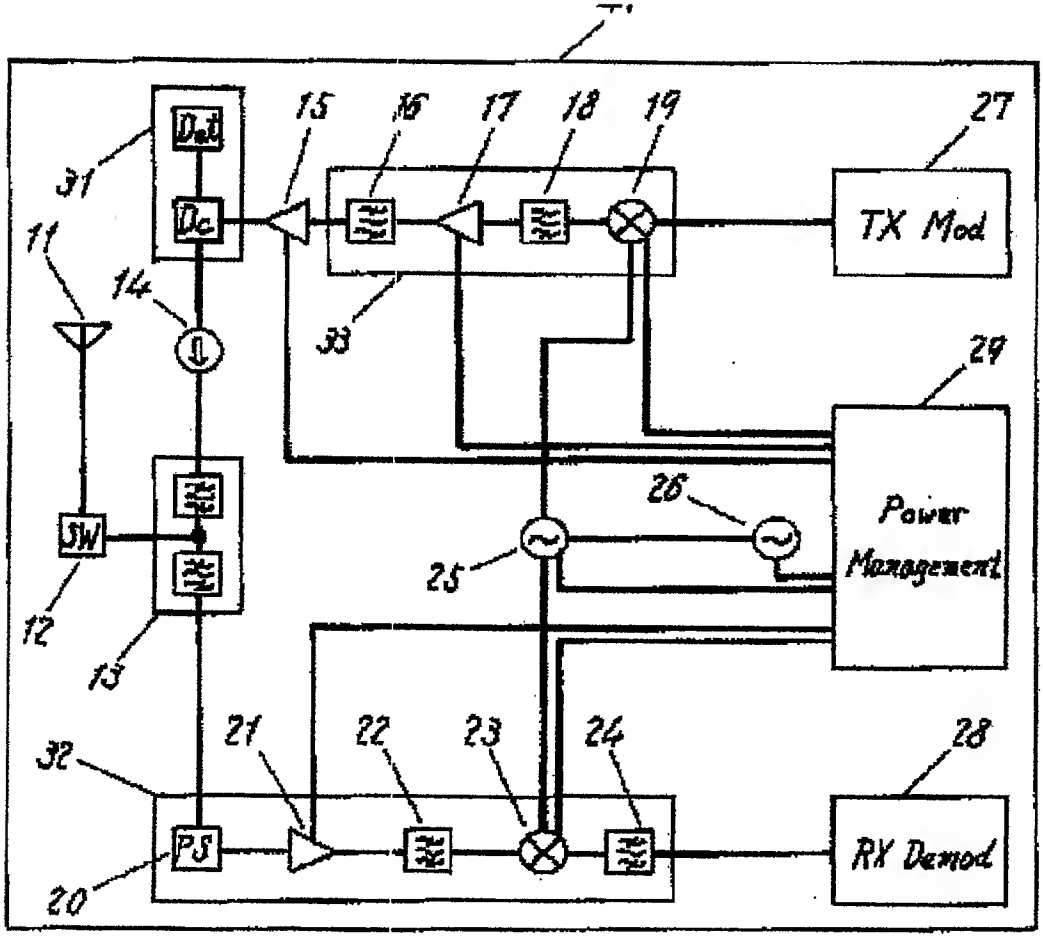
Drawing 5



Drawing 6

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（A）　(11)特許出願公開番号
特開2001－127652
（P2001－127652A）
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					X　5K011
	1/40			1/40	5K052
H05K	3/46		H05K	3/46	Z

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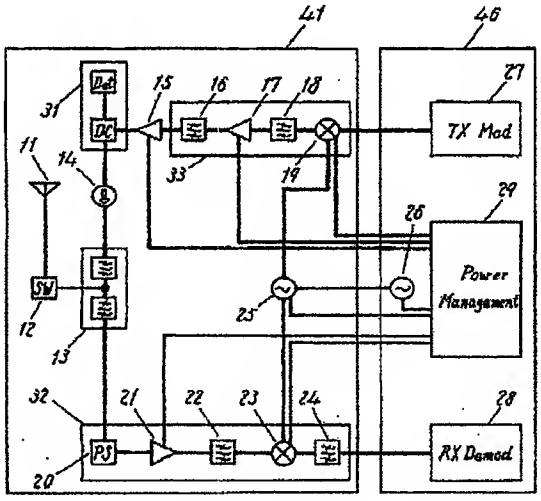
最終頁に続く

(54)【発明の名称】　高周波無線装置

(57)【要約】
【課題】　携帯電話や情報通信端末に利用される高周波無線回路装置において、高周波無線回路装置の受信感度劣化を防止することを目的とする。
【解決手段】　アンテナポート１１、アンテナスイッチ１２、アンテナ共用器１３、アイソレータ１４、電力増幅器１５、第１のフィルタ１６、送信増幅器１７、第２のフィルタ１８、送信ミキサ１９、移相器２０、低雑音増幅器２１、第３のフィルタ２２、受信ミキサ２３、第４のフィルタ２４、ＰＬＬ発振器２５を多層基板の一方の面４１に配置し、基準信号発振器２６、送信変調器２７、受信復調器２８、電源制御回路２９を多層基板の他方の面４６に配置することにより、高周波無線回路装置の受信感度劣化を防止することができる。



【特許請求の範囲】

【請求項１】　多層基板の一方の面に、アンテナポートとアンテナ共用器のアンテナ端子との間にアンテナスイッチを接続し、前記アンテナ共用器の送信端子と電力増幅器の出力端子との間にアイソレータを接続し、前記電力増幅器の出力端子と電力モニター出力ポートとの間に電力検波器を接続し、前記電力増幅器の入力端子と送信増幅器の出力端子との間に第１のフィルタを接続し、前記送信増幅器の入力端子と送信ミキサのＲＦ出力端子との間に第２のフィルタを接続し、前記送信ミキサのＩＦ入力端子をＩＦ入力ポートとし、前記アンテナ共用器の受信端子と低雑音増幅器の入力端子との間に移相器を接続し、前記低雑音増幅器の出力端子と受信ミキサのＲＦ入力端子との間に第３のフィルタを接続し、前記受信ミキサのＩＦ出力端子とＩＦ出力ポートの間に第４のフィルタを接続し、前記送信ミキサのＬＯ入力端子と前記受信ミキサのＬＯ入力端子とを接続するとともにＰＬＬ発振器の出力端子に接続した回路を構成し、前記多層基板の他方の面に、送信変調器と受信復調器と電源制御回路と基準信号発振器と信号接続端子とを設け、前記ＩＦ入力ポートを前記送信変調器の出力端子に接続し、前記ＩＦ出力ポートを前記受信復調器の入力端子に接続し、前記基準信号発振器の出力を前記ＰＬＬ発振器の入力端子に接続した高周波無線装置。

【請求項２】　多層基板は、一方の面と他方の面を含め、少なくとも６層以上で構成し、前記一方の面を第１層とし、前記他方の面を第６層とし、接地パターンを第２層および第４層とし、前記一方の面に設けた回路を前記第１層および第３層で接続し、前記他方の面に設けた回路を第５層と前記第６層で接続した請求項１記載の高周波無線装置。

【請求項３】　第１のレギュレータで送信増幅器と送信ミキサと低雑音増幅器と受信ミキサを電源制御し、第２のレギュレータでＰＬＬ発振器と基準信号発振器を電源制御し、第３のレギュレータで送信変調器と受信復調器を電源制御した請求項１記載の高周波無線装置。

【請求項４】　電力増幅器を電源制御するトランジスタのドレイン端子は、少なくとも４端子以上で構成し、前記電力増幅器の第１の電源端子と前記電力増幅器の第２の電源端子に前記電源制御するトランジスタのドレイン端子を２端子以上ずつ振り分けることを特徴とした請求項１記載の高周波無線装置。

【請求項５】　受信ミキサのＬＯ入力端子にノッチ回路を設けた請求項１記載の高周波無線装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、携帯電話や情報通信端末に利用される高周波無線装置に関する。

【０００２】

【従来の技術】従来、この種の高周波無線回路装置は図６に示す構成となっていた。図６において、１１はアンテナポート、１２はアンテナスイッチ、１３はアンテナ共用器、１４はアイソレータ、１５は電力増幅器、１６は第１のフィルタ、１７は送信増幅器、１８は第２のフィルタ、１９は送信ミキサ、２０は移相器、２１は低雑音増幅器、２２は第３のフィルタ、２３は受信ミキサ、２４は第４のフィルタ、２５はＰＬＬ発振器、２６は基準信号発振器、２７は送信変調器、２８は受信復調器、２９は電源制御回路であり、これら全てを多層基板の一方の面４１に構成し、他方の面は接地パターンとしていた。

【０００３】

【発明が解決しようとする課題】多層基板の一方の面に全ての回路を構成した場合、送信変調器もしくは受信復調器から発生するデジタルノイズがアンテナもしくは低雑音増幅器に混入し、受信感度を劣化させるという課題があった。この高周波無線装置においてはアンテナポートでの受信感度向上が要求されている。

【０００４】本発明は、デジタルノイズを発生させる送信変調器および受信復調器をアンテナポートおよび低雑音増幅器を配置している多層基板の一方の面とは異なる側の他方の面に配置するとともに多層基板の内層に接地パターンを設けることにより、アンテナもしくは低雑音増幅器にデジタルノイズが混入するのを防止し、高周波無線装置の受信感度を向上させることを目的とする。

【０００５】

【課題を解決するための手段】上記目的を達成するために本発明による高周波無線回路装置は、多層基板の一方の面に、アンテナポートとアンテナ共用器のアンテナ端子との間にアンテナスイッチを接続し、前記アンテナ共用器の送信端子と電力増幅器の出力端子との間にアイソレータを接続し、前記電力増幅器の出力端子と電力モニター出力ポートとの間に電力検波器を接続し、前記電力増幅器の入力端子と送信増幅器の出力端子との間に第１のフィルタを接続し、前記送信増幅器の入力端子と送信ミキサのＲＦ出力端子との間に第２のフィルタを接続し、前記送信ミキサのＩＦ入力端子をＩＦ入力ポートとし、前記アンテナ共用器の受信端子と低雑音増幅器の入力端子との間に移相器を接続し、前記低雑音増幅器の出力端子と受信ミキサのＲＦ入力端子との間に第３のフィルタを接続し、前記受信ミキサのＩＦ出力端子とＩＦ出力ポートの間に第４のフィルタを接続し、前記送信ミキサのＬＯ入力端子と前記受信ミキサのＬＯ入力端子とを接続するとともにＰＬＬ発振器の出力端子に接続した回路を構成し、前記多層基板の他方の面に、送信変調器と受信復調器と電源制御回路と基準信号発振器と信号接続端子とを設け、前記ＩＦ入力ポートを前記送信変調器の出力端子に接続し、前記ＩＦ出力ポートを前記受信復調器の入力端子に接続し、前記基準信号発振器の出力を前記ＰＬＬ発振器の入力端子に接続したことを特徴とする

ものである。

【０００６】これにより、高周波無線装置のアンテナポートおよび低雑音増幅器にデジタルノイズが混入するのを防止でき、受信感度を向上させることができる。

【０００７】

【発明の実施の形態】本発明の請求項１に記載の発明は、多層基板の一方の面に、アンテナポートとアンテナ共用器のアンテナ端子との間にアンテナスイッチを接続し、前記アンテナ共用器の送信端子と電力増幅器の出力端子との間にアイソレータを接続し、前記電力増幅器の出力端子と電力モニター出力ポートとの間に電力検波器を接続し、前記電力増幅器の入力端子と送信増幅器の出力端子との間に第１のフィルタを接続し、前記送信増幅器の入力端子と送信ミキサのＲＦ出力端子との間に第２のフィルタを接続し、前記送信ミキサのＩＦ入力端子をＩＦ入力ポートとし、前記アンテナ共用器の受信端子と低雑音増幅器の入力端子との間に移相器を接続し、前記低雑音増幅器の出力端子と受信ミキサのＲＦ入力端子との間に第３のフィルタを接続し、前記受信ミキサのＩＦ出力端子とＩＦ出力ポートの間に第４のフィルタを接続し、前記送信ミキサのＬＯ入力端子と前記受信ミキサのＬＯ入力端子とを接続するとともにＰＬＬ発振器の出力端子に接続した回路を構成し、前記多層基板の他方の面に、送信変調器と受信復調器と電源制御回路と基準信号発振器と信号接続端子とを設け、前記ＩＦ入力ポートを前記送信変調器の出力端子に接続し、前記ＩＦ出力ポートを前記受信復調器の入力端子に接続し、前記基準信号発振器の出力を前記ＰＬＬ発振器の入力端子に接続したものであり、高周波無線装置のアンテナポートおよび低雑音増幅器に送信変調器および受信復調器からのデジタルノイズが混入するのを防止できるという作用を有する。

【０００８】請求項２記載の発明は、多層基板は、一方の面と他方の面を含め、少なくとも６層以上で構成し、前記一方の面を第１層とし、前記他方の面を第６層とし、接地パターンを第２層および第４層とし、前記一方の面に設けた回路を前記第１層および第３層で接続し、前記他方の面に設けた回路を第５層と前記第６層で接続した請求項１記載の高周波無線装置としたものであり、高周波無線装置の受信感度を向上できるという作用を有する。

【０００９】請求項３記載の発明は、第１のレギュレータで送信増幅器と送信ミキサと低雑音増幅器と受信ミキサを電源制御し、第２のレギュレータでＰＬＬ発振器と基準信号発振器を電源制御し、第３のレギュレータで送信変調器と受信復調器を電源制御した請求項１記載の高周波無線装置としたものであり、受信待ち受け時間を向上できるという作用を有する。

【００１０】請求項４記載の発明は、電力増幅器を電源制御するトランジスタのドレイン端子は、少なくとも４端子以上で構成し、前記電力増幅器の第１の電源端子と前記電力増幅器の第２の電源端子に前記電源制御するトランジスタのドレイン端子を２端子以上ずつ振り分けることを特徴とした請求項１記載の高周波無線装置としたものであり、高周波無線装置の送信変調歪特性を改善できるという作用を有する。

【００１１】請求項５記載の発明は、受信ミキサのＬＯ入力端子にノッチ回路を設けた高周波無線装置であり、高周波無線装置の受信妨害排除特性を向上できるという作用を有する。

【００１２】以下、本発明の実施の形態について、図１から図５を用いて説明する。

【００１３】（実施の形態１）図１は、本発明の実施の形態１による高周波無線回路装置を示す電気回路図である。アンテナポート１１とアンテナ共用器１３との間に接続したアンテナスイッチ１２は、外部から高周波無線回路装置を試験するために設けている。本実施の形態においては、スイッチ１２は、機械的に信号経路を切り替えるタイプのものを用いているが、半導体素子を用いたものでも構わない。

【００１４】アンテナ共用器１３は、送信周波数と受信周波数を分離するために設けており、とくに、送信出力が受信側に漏洩しないような分離特性を実現させている。この分離特性は、受信感度が劣化しないように５６ｄＢ以上としている。本実施の形態では、アンテナ共用器１３はＳＡＷにより構成しているが、誘電体で構成してもよい。

【００１５】低雑音増幅器２１は、受信側の低雑音化のために設けており、システムの受信感度を向上させている。本実施の形態では、低雑音増幅器２１の順方向電力利得を１６ｄＢ以上、雑音指数を１．５ｄＢ以下、入力換算の相互変調３次歪み特性を＋１ｄＢｍ以上としている。また、低雑音増幅器２１は、利得を可変できるような利得制御型増幅器としており、強電界妨害波にも耐えるようにしている。このとき可変利得範囲は、１５ｄＢ以上で構成しており、アンテナポート１１において、－２１ｄＢｍの妨害波レベルでも受信感度が劣化しないようにしている。

【００１６】移相器２０は、アンテナ共用器１３と低雑音増幅器２１の間に設けることにより、送信周波数帯が複素共役でインピーダンス整合しないように構成している。こうすることにより、送信周波数帯が低雑音増幅器２１に混入する電力レベルを低減することができ、その結果、妨害排除特性を向上させることが可能となる。なお、移相器２０は、必要でない場合もあることを加えておく。移相器２０が、不必要な条件は、アンテナ共用器１３の受信端子の送信周波数帯インピーダンスと低雑音増幅器２１の入力インピーダンスが、複素共役で整合しない場合である。

【００１７】第３のフィルタ２２は、受信帯域を通過さ

せるとともに送信帯域を減衰させるフィルタであり、本実施の形態では、ＳＡＷを用いた。このとき、送信帯域の減衰量は、１５ｄＢ以上としている。

【００１８】受信ミキサ２３は、受信信号をＩＦ信号に周波数変換するために設けており、デュアルゲート型ミキサで構成した。特性は、順方向電力利得を８ｄＢ以上、雑音指数を８ｄＢ以下、入力換算の相互変調３次歪み特性を＋３ｄＢｍ以上としている。この特性を満たすために、本実施の形態では、受信ミキサ２３にＧａＡｓＭＥＳＦＥＴデバイスを用いた。

【００１９】第４のフィルタ２４は、受信ミキサ２３で周波数変換したＩＦ信号を通過させるとともに他の帯域を減衰させるために設けており、ＳＡＷデバイスで構成している。第４のフィルタ２４の出力は、受信復調器２８に接続し、受信部を構成している。

【００２０】次に送信部を説明する。電力増幅器１５とアンテナ共用器１３の間にはアイソレータ１４を接続しており、電力増幅器１５の負荷がアンテナポート１１により変動しても電力増幅器１５の隣接チャンネル漏洩電力特性が劣化しないようにしている。電力検波回路３１は、送信電力をモニターするために設けており、電力増幅器１５の負荷変動による影響を低減するため、アイソレータ１４の入力側に接続している。

【００２１】第１のフィルタ１６は、送信帯域を通過させるとともに受信帯域を減衰させるために設けている。受信帯域の減衰量は、３０ｄＢ以上としており、電力増幅器１５の入力側で受信帯域雑音レベルが、熱雑音レベルとなるようにしている。送信増幅器１７は、電力増幅器１５が必要とする入力レベルまで増幅するために設けている。本実施の形態では、送信増幅器１７は、利得制御型増幅器としており、送信電力を最小出力レベルに変化させた時でも、送信帯域雑音レベルが増加しないようにしている。

【００２２】第２のフィルタ１８は、送信帯域を通過させるとともに受信帯域を減衰させるために設けている。本実施の形態では、ＳＡＷを用いた。送信ミキサ１９は、送信ＩＦ信号を送信周波数に変換するために設けており、送信変調器２７の出力と接続している。ＰＬＬ発振器２５は、受信ミキサ２３および送信ミキサ１９へのローカル信号源としている。また、基準信号発振器２６は、ＰＬＬ発振器２５の基準周波数源である。電源制御回路２９は、電力増幅器１５、送信増幅器１７、送信ミキサ１９、低雑音増幅器２１、受信ミキサ２３、ＰＬＬ発振器２５、基準信号発振器２６の電源を制御するために設けている。

【００２３】図１に示すごとく本実施の形態においては、多層基板を用いた。多層基板の一方の面４１に、アンテナポート１１、アンテナスイッチ１２、アンテナ共用器１３、アイソレータ１４、電力増幅器１５、第１のフィルタ１６、送信増幅器１７、第２のフィルタ１８、送信ミキサ１９、移相器２０、低雑音増幅器２１、第３のフィルタ２２、受信ミキサ２３、第４のフィルタ２４、ＰＬＬ発振器２５を配置している。このように多層基板の一方の面４１には、ＶＨＦ帯以上の周波数成分を信号として取り扱う部品を構成させている。

【００２４】一方、多層基板の他方の面４６には、基準信号発振器２６、送信変調器２７、受信復調器２８、電源制御回路２９を配置している。このように多層基板の他方の面４６には、ＨＦ帯以下の周波数成分を信号として取り扱う部品を構成させている。

【００２５】このように配置させることにより、第２層の接地パターン４２と第４層の接地パターン４４に多層基板の一方の面４１で接続される電源ラインおよび利得制御ラインなどの直流ラインを電磁界的に閉じ込めることが可能となり、ＶＨＦ帯以上の周波数成分を信号として取り扱う多層基板の一方の面４１に配置したアンテナポート１１、アンテナスイッチ１２、アンテナ共用器１３、アイソレータ１４、電力増幅器１５、第１のフィルタ１６、送信増幅器１７、第２のフィルタ１８、送信ミキサ１９、移相器２０、低雑音増幅器２１、第３のフィルタ２２、受信ミキサ２３、第４のフィルタ２４、ＰＬＬ発振器２５に多層基板の他方の面４６に配置した送信変調器２７および受信復調器２８から発生するＨＦ帯の信号成分を中心としたデジタルノイズを混入するのを防ぐことができる。その結果、高周波無線回路装置の受信感度劣化を防止することが可能となる。

【００２６】（実施の形態２）図２は、本発明の実施の形態２を示す高周波無線回路装置の斜視図である。受信部３２と送信部３３で囲むようにＰＬＬ発振器２５を配置させ、アンテナポート１１に対し、対角となるような位置に構成している。このように配置させることにより、ＰＬＬ発振器２５からのローカル信号が直接、アンテナポート１１に混入しないように配慮している。図２に示すごとく、多層基板の第２層４２および第４層４４は、接地パターンである。多層基板の一方の面４１に配置した回路接続は、多層基板の一方の面４１と多層基板の第３層４３で実施している。デジタルノイズを発生させる送信変調器２７および受信復調器２８の回路接続は、多層基板の他方の面４６と多層基板の第５層４５で実施している。このように第５層４５と多層基板の他方の面４６で、ＨＦ帯以下の周波数成分を信号として取り扱う部品を構成・配置させている。特に、第５層は、直流信号ライン、利得制御ライン、データラインを回路接続させている。

【００２７】一方、ＶＨＦ帯以上の周波数成分を信号として取り扱う部品の回路接続は、多層基板の一方の面４１と第２層４２と第３層４３と第４層４４で実施している。このように第１層４１から第４層４４までをＶＨＦ帯以上の周波数成分を信号として取り扱うようにさせている。本実施の形態に示すごとく、多層基板の層方向に

取り扱う信号の周波数成分を分割、配置、接続することにより、多層基板の第２層および第４層で構成した接地パターンがデジタルノイズに対するシールド効果をより一層、向上させることになり、結果として、高周波無線回路装置の受信感度劣化防止効果を高めることになる。

【００２８】（実施の形態３）本実施の形態においては、図３に示すように電源制御回路２９でコントロールする回路を４つに分けている。１つ目は、電力増幅器１５、２つ目は、送信増幅器１７、送信ミキサ１９、低雑音増幅器２１、受信ミキサ２３、３つ目は、ＰＬＬ発振器２５、基準信号発振器２６、４つ目は、送信変調器２７、受信復調器２８である。１つ目の電力増幅器１５は、ＰチャネルＭＯＳＦＥＴで電源制御７０を実施している。これにより、送信時に最も電流が流れる電力増幅器１５を個別で電源制御することが可能となる。

【００２９】次に２つ目の電源制御７１についてであるが、本実施の形態では、送信側の小信号ブロックを構成する送信部３３と受信側のブロックを構成する受信部３２の電源をまとめている。このようにまとめることにより、送信部３３の電源ラインにトランジスタスイッチを追加するだけで、送信部３３を独立制御することができるとともに受信部３２を電源制御する時には、送信部３３も連動させて制御することが可能となる。

【００３０】３つ目の電源制御７２については、ＰＬＬ発振器２５、基準信号発振器２６のまとめ方である。このように発振ブロックだけをまとめることにより、システム立ち上げ時のタイミング同期に必要な回路ブロックだけ動作させることが可能となる。

【００３１】４つ目の電源制御７３は、送信変調器２７、受信復調器２８であるが、これは、デジタル部を常時立ち上げるために設けている。デジタル部を常時立ち上げることにより、システム動作を常時監視することが可能となり、必要な回路に必要なタイミングだけ、電源を制御させることが可能となる。このように分類させることにより、受信待ち受け時に必要な回路部分（送信増幅器１７、送信ミキサ１９、低雑音増幅器２１、受信ミキサ２３）だけ間欠動作させることができるので、結果として、受信待ち受け時間を伸ばすことが可能となる。

【００３２】（実施の形態４）図４は、本発明の実施の形態４を示す高周波無線回路装置の電気回路図である。図４に示すごとく、電力増幅器１５の第１の電源端子５１と第２の電源端子５２は、ＰチャネルＭＯＳＦＥＴ５０のドレイン５３に接続している。このとき、電力増幅器１５の第１の電源端子５１と第２の電源端子５２は、ＰチャネルＭＯＳＦＥＴ５０のドレイン５３の４つの端子を二分するように接続している。そしてこの状態において、第１のコンデンサ４８が電力増幅器１５の第１の電源端子５１と接地の間に接続されており、第２のコンデンサ４９が電力増幅器１５の第２の電源端子５２と接地の間に接続されている。

【００３３】これにより、第１のコンデンサ４８と第１の電源端子５１の線路でフィルタが構成され、第２のコンデンサ４９と第２の電源端子５２の線路でフィルタが構成される。このとき構成されるフィルタは、電力増幅器１５の動作周波数に対して電源端子から混入するノイズ成分を除去できる効果的なフィルタである。

【００３４】電源端子５１と電源端子５２を接続してしまうと、線路長が短くなり、電力増幅器１５の動作周波数より高い周波数で効果的なフィルタとなってしまい、電力増幅器１５で増幅された送信出力波の変調歪特性の劣化を防止することができなくなってしまう。

【００３５】本実施の形態に示すように、電力増幅器１５の第１の電源端子５１と第２の電源端子５２を分離することにより、それぞれの電源端子が独立した状態で高周波分離でき、その結果、電力増幅器１５で増幅された送信出力波の変調歪特性の劣化を防止することが可能となる。

【００３６】（実施の形態５）図５は、本発明の実施の形態５を示す高周波無線回路装置の電気回路図である。図５に示すごとく、ノッチフィルタ４７が、ＰＬＬ発振器２５の出力に接続されている。本実施の形態では、ノッチフィルタ４７の周波数を送信周波数帯としている。このノッチフィルタ４７は、ＳＡＷ、ＬＣ、誘電体でもよいが、回路構成を簡素化するため、送信周波数帯において自己共振周波数となるようなチップ型コンデンサを使用している。

【００３７】このように構成することにより、電力増幅器１５で増幅された送信信号が、受信ミキサ２３に混入するのを防ぐことができる。その結果、受信感度の劣化を防止することが可能となる。なお、受信ミキサ２３に混入する送信信号レベルおよび他の雑音レベルが、受信感度の劣化を引き起こさないレベルすなわち、熱雑音レベル以下であれば、ノッチフィルタ４７が不要となることを加えておく。

【００３８】

【発明の効果】以上のように本発明によれば、高周波無線回路装置のアンテナポートおよび低雑音増幅器へのデジタルノイズの混入を防止することが可能となり、受信感度を劣化させるという課題を解決することができるという有利な効果が得られる。

【図面の簡単な説明】

【図１】本発明の実施の形態１による高周波無線回路装置を示す電気回路図

【図２】本発明の実施の形態２による高周波無線回路装置を示す斜視図

【図３】本発明の実施の形態３による高周波無線回路装置を示す電気回路図

【図４】本発明の実施の形態４による高周波無線回路装置を示す電気回路図

【図５】本発明の実施の形態５による高周波無線回路装

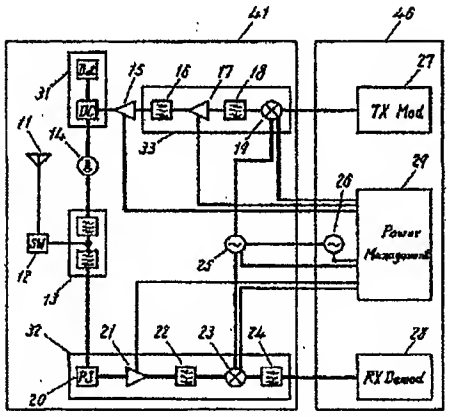
置の要部構成を示す電気回路図

【図６】従来の高周波無線回路装置を示す電気回路図

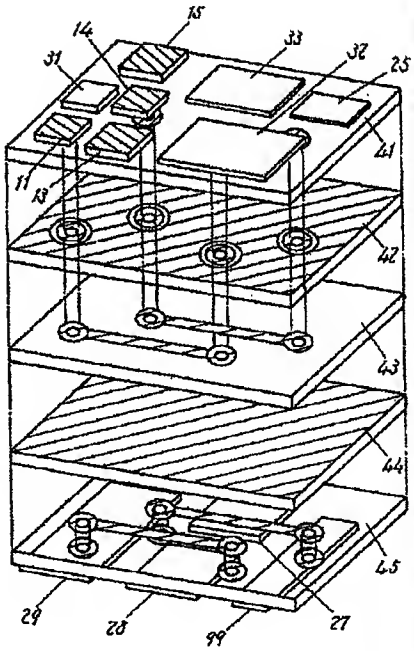
【符号の説明】

１１　アンテナポート
１２　アンテナスイッチ
１３　アンテナ共用器
１４　アイソレータ
１５　電力増幅器
１６　第１のフィルタ
１７　送信増幅器
１８　第２のフィルタ
１９　送信ミキサ
２０　移相器
２１　低雑音増幅器
２２　第３のフィルタ
２３　受信ミキサ
２４　第４のフィルタ
２５　ＰＬＬ発振器
２６　基準信号発振器
２７　送信変調器
２８　受信復調器
２９　電源制御回路
３１　電力検波回路
３２　受信部
３３　送信部
４１　多層基板の一方の面（第１層）
４２　第２層
４３　第３層
４４　第４層
４５　第５層
４６　多層基板の他方の面（第６層）
４７　ソース
４８　第１のコンデンサ
４９　第２のコンデンサ
５０　ＰチャネルＭＯＳＦＥＴ
５１　第１の電源端子
５２　第２の電源端子

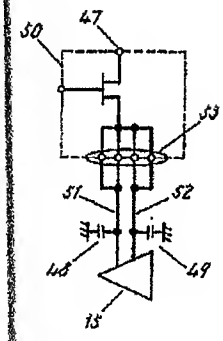
【図１】



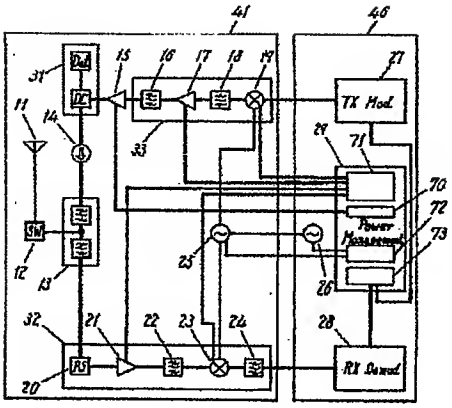
【図２】



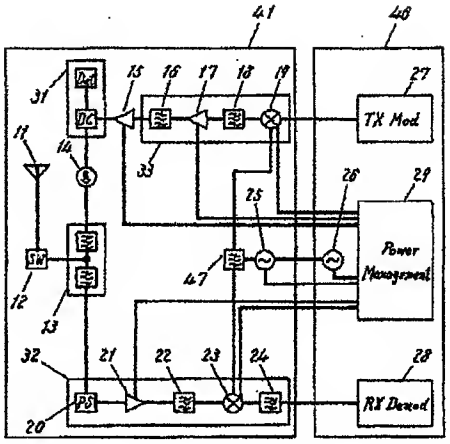
【図４】



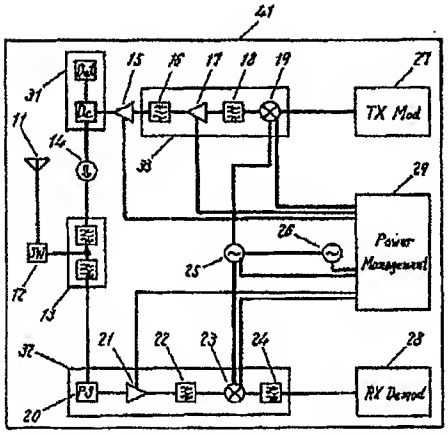
【図3】



【図5】



【図6】



フロントページの続き

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5K011 AA04 DA00 JA01 KA00
5K052 AA00 BB01 DD16 FF01 FF38 GG35

Partial translation of JP2001-127652A: paragraph 0013 (page 3), paragraph 0023 (page 4), paragraph 0026 (page 4), and Fig. 1 to Fig. 2 (page 6) of the specification.

[0013]

(Preferred Embodiment 1)

Fig. 1 is an electric circuit diagram showing a high-frequency radio circuit device in the preferred embodiment 1 of the present invention. Antenna switch 12 connected between antenna port 11 and antenna sharing unit 13 is provided for the purpose of externally testing the high-frequency radio circuit device. In this preferred embodiment, switch 12 is a type of switch which mechanically switches the signal route, but it is allowable to be a switch using semiconductor elements.

[0023]

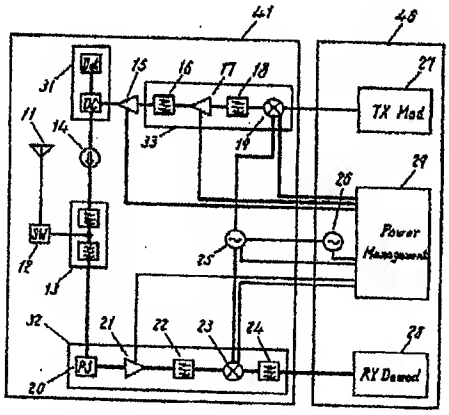
As shown in Fig. 1, a multi-layer substrate is used in the present preferred embodiment. Antenna port 11, antenna switch 12, antenna sharing unit 13, isolator 14, power amplifier 15, first filter 16, transmission amplifier 17, second filter 18, transmission mixer 19, phase shifter 20, low noise amplifier 21, third filter 22, receive mixer 23, fourth filter 24, and PLL oscillator 25 are arranged on one surface 41 of the multi-layer substrate. Thus, on one surface 41 of the multi-layer substrate are disposed parts which handle a frequency component higher than VHF band as a signal.

[0026]

(Preferred Embodiment 2)

Fig. 2 is a perspective view of a high-frequency radio circuit device showing the preferred embodiment 2 of the present invention. PLL oscillator 25 is arranged in such a manner that it is surrounded by receiver 32 and transmitter 33, and is disposed in a position diagonal to antenna port 11. With it arranged in such a position, local signals from PLL oscillator 25 can be prevented from directly mixing into antenna port 11. As shown in Fig. 2, second layer 42 and fourth layer 44 of the multi-layer substrate are of ground pattern. The circuit connection arranged on one surface 41 of the multi-layer substrate is made by one surface 41 of the multi-layer substrate and third layer 43 of the multi-layer substrate. The circuit connection of transmitting modulator 27 and receiving demodulator 28 which generate digital noise is made by the other surface 46 of the multi-layer substrate and fifth layer 45 of the multi-layer substrate. In this way, parts which handle a frequency component lower than HF band as a signal are formed and arranged by fifth layer 45 and the other surface 46 of the multi-layer substrate. Particularly, the fifth layer makes the circuit connections of the DC signal line, gain control line, and data line.

[Fig. 1]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TX Mod
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Power Management
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RX Demod
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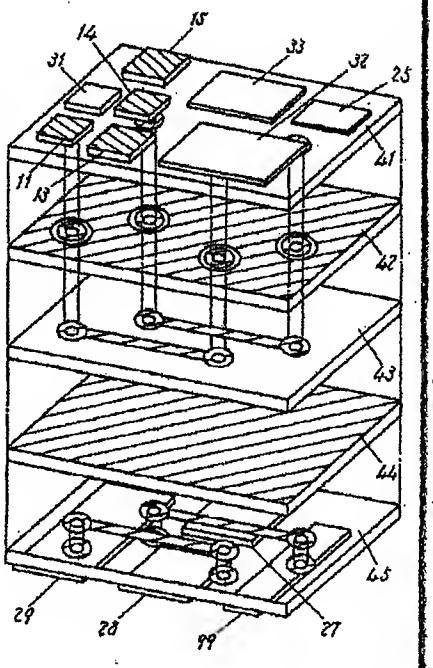
[Fig. 2]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